REMARKS

Following the amendments above, claims 1-54 are pending. Claims 1, 33, 39, 40, 41, and 45 are the independent claims.

Regarding the objection to the drawings and the specification, we have amended the specification as shown above to mention reference numerals 105, 510, and 530, and we have amended the specification to correct the error identified by the Examiner at page 10, line 30.

The action rejected claims 1-16, 27, 28, and 30-48 as unpatentable over U.S. Patent 6,359,692 to de Groot (hereinafter "Groot") in view of the Applied Physics article (30:4046-4055, 1991) by Suematsu et al. (hereinafter "Suematsu"). We traverse.

The action concedes that the analysis of the interferometry data in Groot is different from that in each of the independent claims. The action alleges to find that which is missing from Groot in Suematsu, particularly its description of optical frequency domain reflectometry (OFDR). With respect to independent claims 1, 39, 41, and 45, the actions states at page 9 - "it would have been obvious to one having ordinary skill in the art to provide OFDR analysis of the interferometry data in the interferometry system of Groot, in order to determine a phase and optical path distance for each of the selected pairs of surfaces." Similarly, with respect to independent claims 33 and 40, the action states at page 11 – "it would have been obvious to one having ordinary skill in the art to provide an OFDR analysis of the interferometry system of Groot in order to determine an absolute optical thickness for each of the selected pairs of surfaces." Thus, the rejections are all based on performing an OFDR analysis as described in Suematsu on the interferometry data of Groot.

We submit that the proposed modification must fail because: 1) there is no motivation to perform the OFDR analysis of Suematsu on the interferometry data of Groot; and 2) even if there were such motivation, the OFDR analysis is fundamentally incompatible with the teachings of Groot. Finally, even if the proposed modification were to stand, it still fails to provide all of the features of many, if not all, of the claims.

Groot wants to determine a phase profile (e.g., a surface height profile) of a selected surface from interference data that includes interference patterns associated with multiple

surfaces (see, e.g., Groot at: col. 4, lines 21-25; col. 5, lines 5-10; and col. 6, lines 29-32). To accomplish this, Groot uses an algorithm that purposefully suppresses the contribution of interference data from unwanted surfaces (see, e.g., Groot at: col. 2, lines 8-12; col. 5, line 1-5; and col. 8, lines 24-28). In contrast, Suematsu uses OFDR to simultaneously measure the distance between each of multiple surfaces in series. For example, at page 4047, left column, Suematsu states: "OFDR has the marked advantage that it allows us to read the distances of multiple reflectors" (see also Fig. 2 in Suematsu).

Thus, the two references are inherently contradictory - Groot makes multiple distance measurements to a single surface (e.g., he measures a surface profile), whereas Suematsu makes a single distance measurement to each of multiple surfaces. We fail to see how there can be motivation to combine such contradictory references, and accordingly, submit that the rejections must be withdrawn.

Moreover, the OFDR analysis of Suematsu is fundamentally incompatible with Groot's emphasis on determining a phase profile for the selected surface. For example, Groot states:

> "For each spatial coordinate (x,y) controller 60 employs a phase-shifting algorithm to extract the phase-offset for the sinusoidally varying intensity values. Together, the phase-offsets provide the phase profile $\theta(x,y)$." (col. 6, lines 26-32).

Additional examples of Groot's emphasis on determine a phase profile can be found at: col. 2, lines 8-12; col. 2, lines 23-30; col. 2, lines 59-61; col. 3, lines 36-38; col. 4, lines 4-6; col. 5, lines 3-5; and col. 6, lines 16-18. Groot obtains the phase profile $\theta(x,y)$ from the intensity profile $g(\theta(x,y),t)$ of the interference pattern corresponding to the selected surface (see Eq. 1 in Groot). The surface profile $h(x,y)$ is calculated directly from the phase profile $\theta(x,y)$ (see Groot at col. 6, lines 29-32). Notably, the phase profile $\theta(x,y)$ is time-independent - it is the time-independent phase variation or "offset" across the time-varying interference intensity pattern $g(\theta(x,y),t)$.

In contrast, OFDR as described in Suematsu does not calculate any such phase profile or offset. To the contrary, Suematsu states:

"The principle of the OFDR is to determine f_s from the peak position of the spectrum $C(f - f_s)$ and the compute L from Eq. (9) [which directly relates the peak frequency f_s to the distance L]" (page 4048, right column).

Thus OFDR as taught by Suematsu completely ignores the time-independent phase offset in the Fourier transform and calculates distance directly from the frequency of the peaks in the transform.

The OFDR calculation in Suematsu may be appropriate for determining absolute distances to each of a series of reflectors (see Fig. 2 in Suematsu), however, Groot is interested surface height variations across a selected surface (e.g., one of the reflectors). Indeed, the surface height resolution required by Groot is inherently on the order of a wavelength (see the Equation at col. 6, line 32 in Groot), and Suematsu concedes that the resolution of OFDR is poor - he states:

"Although OFDR has the marked advantage that it allows us to read the distances of multiple reflectors from the locations of the spectrum peaks, the range resolution is limited by the spread of the spectrum peaks" (page 4047, left column, emphasis added).

Thus, we submit that the proposed modification must fail because OFDR as described by Suematsu completely disregards that which Groot emphasizes - determining a phase profile. Therefore the references teach away from the proposed modification. Moreover, there is no indication in Suematsu that the resolution of the resulting OFDR analysis would even be sufficient to provide the surface height profile desired by Groot. To the contrary, Suematsu suggests otherwise, as quoted in the prior paragraph. Therefore, we ask the Examiner to withdraw the rejection.

We note that Suematsu also describes a Fourier transform technique ("FTT"), which is different from OFDR (see, e.g., page 4047, left column). For completeness, we point out that Suematsu's FTT technique, like the OFDR technique, is also incompatible with the phase profiling objective of Groot. In the FTT technique, Suematsu purposefully eliminates the time-independent phase offset (which is the means through which Groot calculates surface profile), and, as in OFDR, calculates an absolute distance L directly from frequencies. For example, Suematsu states:

> "To eliminate the unknown constant phases ϕ_0 and ϕ_{R0}, we differentiate the [time-varying] phases and obtain instantaneous angular frequencies: ... From the ratio of $\omega_S(t)$ and $\omega_R(t)$ [the angular frequencies], we can compute the optical path difference L [according to Eq. (21)]" (page 4049, left column).

Therefore, we submit that even if there were motivation to modify Groot according to Suematsu's FTT technique, something we in no way concede, Groot teaches contrary to such a modification because he emphasizes the importance of calculating a time-independent phase profile or offset.

Finally, even if the proposed combination of Groot and Suematsu is permissible, which we dispute, we submit that action does explain how the proposed combination provides each element of the rejected claims. For example, rejected claims 1, 39, 41, and 46 recite "extracting the phase of the frequency transform," "extracts the phase of the frequency transform," "extracting the phase of the transformed signal," and "extracts the phase of the transformed signal," respectively. As described above, however, the OFDR analysis in Suematsu completely <u>disregards</u> this phase (and the FTT analysis expressly eliminates it). Thus, these claims distinguish the proposed combination set forth in the action and the rejection against them should be withdrawn.

Also, for example, rejected claims 41 and 45 recite "identifying a peak in the spectrum ... and for each location, transforming the interference signal with respect to the identified peak" and "identifies a peak in the spectrum ... and for each location, transforms the interference signal with respect to the identified peak," respectively. But, as described above, the OFDR analysis in Suematsu calculates distance directly from the frequency of the identified spectrum peaks, so there is no subsequent transformation of the interference signal with respect to the identified spectrum peaks. Thus, these claims distinguish the proposed combination set forth in the action and the rejection against them should be withdrawn.

Therefore, even if the proposed combination of references were to stand, which we dispute, it still fails to provide all of the features of many, if not all, of the claims.

In view of the above, we ask that all claims be allowed. Enclosed is a check for excess claim fees and a check for the Petition for Extension of Time fee. Please apply any other charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

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***See attached document certifying that Marc M. Wefers has limited recognition to practice before the U.S. Patent and Trademark Office under 37 C.F.R. §10.9(b).**

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Version with markings to show changes made

In the specification:

Paragraph beginning at page 10, line 11 has been amended as follows:

-- During operation, light source **140** directs light 105 having an optical frequency ν to beam splitter **150**, which then directs the light to collimating lens **130** to collimate the light into a plane field. Optionally, a second beamsplitter (not shown) directs a portion of the light to an optical frequency monitor, described further below with reference to FIG. 5. Surface **121** reflects a first portion of the light 105 to form a first reference wavefront **105a**, and surfaces **102** and **103** of object **101** reflect additional portions of light to form wavefronts **105b** and **105c** respectively. Surface **111** also reflects a portion of light to form a second reference wavefront **105d**. Lenses **130** and **160** then image wavefronts **105a**, **105b**, **105c**, and **105d** onto CCD camera **170** where they form an optical interference pattern. The optical interference pattern also includes contributions from higher order reflections within cavity **109**. Higher order reflections include, for example, interference between light reflecting from surface **121** and light that reflects first off surface **102**, then by surface **121**, and then again by surface **102**.--

Paragraph beginning at page 10, line 23 has been amended as follows:

-- In the analysis that follows, we first consider the optical interference pattern produced by optical frequency tuning in an elemental two-surface interferometer cavity, for example, the cavity formed by surface **121** and surface **102**. The surfaces are separated by a physical gap L and contain a medium with a refractive index n. For example, the gap can be filled with air, which has a refractive index of about one. The product of refractive index and gap thickness, nL, is referred to as the optical thickness (for air this is equal to the physical

thickness, L). The total phase difference, φ, between light rays with wavenumber k reflected from surface <u>**121**</u> [**102**] and light rays which reflect from surface <u>**102**</u> [**103**] p times is given by:

$$\varphi(x,y) = 2pknL(x,y) + \Phi = 2pnL(x,y)\frac{2\pi v}{c} + \Phi, \qquad (1)$$

where ν is the optical frequency of the light, c is the speed of light, and Φ is an overall constant phase. The x and y dependence of gap L and phase φ are shown explicitly in EQ. 1 to show the spatial variation in phase. In some embodiments, refractive index n may also have an x and y dependence. Extraction of this phase variation profile, or phase map, is the information that is typically of interest in PSI. This explicit x and y dependence will be omitted in the equations that follow for the sake of clarity. --

Paragraph beginning at page 20, line 1 has been amended as follows:

-- A polarized input beam <u>**510**</u> from light source **140** is directed into HSPMI **501** via reflector **511**. Roof prism **522** is positioned below the plane of the page, such that the input beam to the interferometer passes over it. In some embodiments, the input beam is linearly polarized at 45°, or it can be circularly polarized. Beamsplitter **520** splits the input beam into orthogonally polarized reference and measurement beams. The reference beam is twice directed between mirror **515** and cube-corner retro-reflector **521** before being directed to roof prism **522**. Similarly, the measurement beam is twice directed between mirror **540** and cube-corner retro-reflector **521** <u>via measurement distance 530</u>. Following the second pass to mirrors **515** and **540**, respectively, cube-corner retro-reflector **521** lowers the reference and measurement beams to the plane of roof prism **522**, which causes the beams to make two additional passes to mirrors **515** and **540**. Thereafter, the beams are recombined into an output beam, which is directed to quadrature detector **505**.--

In the claims:

Claim 32 has been amended as follows:

32. The method of claim 30, wherein the calculation of [calculating] the frequency transform is based on the monitored frequency tuning.

BEFORE THE OFFICE OF ENROLLMENT AND DISCIPLINE
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